

AMENDMENTS TO THE DRAWINGS:

The attached sheet of drawings replaces the original Figures 1-11 with renumbered Figures 1-7. Such replacement and renumbering introduces no new matter.

Attachment: Replacement Sheet

REMARKS

Claims 1-17 remain in this application.

Applicants have amended the specification and abstract. The extent and nature of the amendments are such that applicants include herewith a substitute specification. In accordance with 37 CFR §1.125, applicants have enclosed both a version with markings showing all changes as well as a clean version.

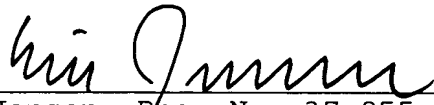
Applicants, through their counsel, state that the substitute specification includes no new matter.

Entry of the above amendments is earnestly solicited. An early and favorable first action on the merits is earnestly requested.

Should there be any matters that need to be resolved in the present application, the Examiner is respectfully requested to contact the undersigned at the telephone number listed below.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.
Respectfully submitted,

YOUNG & THOMPSON



Eric Jensen, Reg. No. 37,855
745 South 23rd Street
Arlington, VA 22202
Telephone (703) 521-2297
Telefax (703) 685-0573
(703) 979-4709

EJ/lmt

APPENDIX:

The Appendix includes the following item(s):

- ☒ - a new or amended Abstract of the Disclosure
- ☒ - three Replacement Sheets of the drawings
- ☒ - a Substitute Specification and a marked-up copy of the originally-filed specification
- ☐ - a terminal disclaimer
- ☐ - a 37 CFR 1.132 Declaration
- ☐ - a verified English translation of foreign priority document

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DT01 Rec'd PCT/FTC 27 DEC 2004

MARKED-UP VERSION OF SUBSTITUTE SPECIFICATION

PULLING V-BELT

The present invention relates to a pull type belt as defined in the preamble of claim 1.

5 Such belts are generally known in the art, either for application in fixed ratio, or for variable ratio transmissions. Such so called V-belts, simply called "rubber belts", have since long essentially been produced with a body of a natural or synthetic rubber material, and have a reinforcing tensile means in the form of a layer of a plurality of tensile elements such as cords, e.g. produced in a synthetic fibre. Commonly the
10 cords are incorporated in one layer, with the cords lying side by side. The tensile means is embedded in a rubber material. Within the layer, sometimes denoted cushion layer, commonly a specific type of rubber is applied for optimising the bounding between rubber and tensile element.

 One limitation of this known type of belt is that the amount of transmissible
15 power, ~~to be transferred from one pulley to another, by a wedging, i.e. clamping action of the sheaves of a pulley,~~ is limited by the amount of power that can be transferred from the rubber to the tensile means. Thus, the force transferable from one pulley to the other is limited by the maximum load of the connection between the rubber and the cords within the belt.

20 Another and major drawback of the known V-belt concerns the smallest running diameter that can be attained at a virtually infinite time of operation of the belt. This phenomenon is especially relevant at V-belts for application in variable ratio transmissions. In these applications it is important to have a sufficiently lateral bearing or contacting surface for contacting the sheaves of a pulley, so as to guarantee a
25 proper and smooth shifting and running feature of the belt. However, this requirement increases the radial height of the conventional V-belt and therewith the bending stress in the belt. Bending stress occurs in a high extend at the radial outer side of a belt. ~~Probably for this reason, the tensile elements of the known, i.e. conventional rubber belt are located closest possible to the radial outer surface of belt.~~ The bending stress
30 also affects the connection between the body and the tensile elements, which connection plays an important role because of a requirement to have a sufficiently large surface area on the tensile elements for bonding, i.e. adhering these to the body material of the belt. ~~The bonding should be such that a meaningful amount of force can be transmitted still during e.g. an industrially meaning full period of operation time~~
35 ~~of the belt.~~

~~One solution for reducing internal bending stress commonly applied in commercialised belts is to provide laterally extending, generally V-shaped openings at the radial interior side of the belt. In this way the bending height of the belt is reduced with the radial depth of the openings. Still a relatively high pulley contacting face may be maintained at the rubber bodies between these grooves. Consequently, the bending stress is reduced proportionally with the depth of the groove.~~

~~Yet, m~~Many commercial applications still require a low cost solution with an even smaller smallest running diameter feature of the belt, e.g. at application in the drive line of scooters, or under the bonnet of a personal vehicle where space is scarce. Scooters have, located near the rear wheel, a relatively bulky transmission case as part of the drive line. The drive line, in particular the bulkiness thereof limits the design freedom of this two-wheeled motorised vehicle.

~~One manner for attaining a very small running diameter of a rubber belt is to design a relatively wide width belt with a plurality of endless V-shaped grooves provided longitudinally to the interior, i.e. the radial inner side of the belt. In this manner a belt of relatively low height, allowing a relatively small smallest running diameter is attained. In this solution the ratio is fixed and the belt is no longer applicable in a variable transmission.~~

~~Another disadvantage of the known V-belt is that the rubber body required for proper clamping between the sheaves of a pulley is entirely disposed at the radial inner side of the tensile means. Location at the radial outer side of the tensile means could cause the rubber body part to deform, i.e. to bulge out in radial direction, under the clamping action. The deformation may be such that the function of the body is lost at least to a large extent. Bulging out is in conventional V-belts a.o. counteracted by a radial outer layer of reinforced material. The clamping body for the belt is consequently situated below the tensile means, i.e. at the radial inner side of the belt. When transmissions with small diameters are sought for, e.g. at limited space applications, this phenomenon reduces the range of transmission ratios that can be attained.~~

Another high power solution known in the art of pull belts is provided by EP-A-0 826 901. This solution describes a relatively expensive belt of a relatively complicated structure, directed to and particularly suitable for relatively high power transmission systems. The design of this belt features transverse elements, so-called blocks, having a fixed position relative to a tensile means, denoted load carrier. The load carrier consists of two endless parts, each of which is placed into laterally extending slots of the transverse elements. The load carriers each have an an rubber like-elastically

deformable ~~material~~ body of noticeable height, in which a centred ~~layer of tensile elements in the form of strings~~ is incorporated. The tensile means and the manner of incorporation correspond to what is known from conventional V-belts, and have the associated draw back of limited transfer of force per unity of width. The transverse

5 elements ~~of this type of belt are produced with~~ have a metal core coated with a synthetic material so as to achieve both a desired amount of axial stiffness and a required amount of friction with ~~the sheaves of a pulley~~. ~~This design renders a relatively complicated manufacture. Also, the body of the load carriers or tensile means show a relatively complicated profiled shape, different at the radial inner and~~

10 ~~the radial outer surface, and matching the profiling of the lateral slots of the transverse elements.~~ After the driving force has been transmitted from the sheaves to the transverse elements, the latter carry this force over to the tensile bodies by ~~said a~~ different upper and lower profiling therein. Subsequently the force is conducted from the body of the load carrier to the layer of cords in the conventional manner. ~~The~~

15 ~~profiling of the elements and of load carrier per se, each with two shapes, may disadvantageously form an additional drawback at manufacture of the belt.~~

Yet another ~~proposal for improvement of the conventional V-belts~~ solution is provided by US 4,915,677. The publication discloses a pull belt with one or a plurality of a so-called tension resistant members, embodied by a layer of cables. This known

20 pull belt is preferably provided with metal ~~transverse~~ elements ~~preferably of a metal material~~ which are opened to the radial outer side by a recess. The bottom ~~side~~ of the recess is profiled for receiving a plurality of cables disposed in a layer at a level in the upper, i.e. radial outer half of the elements. For ~~the sake of~~ improvement of the force distribution ~~in the element~~, a filler element is present, filling the recess and aiding ~~in~~

25 the bonding between the cables and the elements. The bonding is enhanced by an elastomeric mass joining the transverse elements and the tension resistant member. ~~Thus, also the~~ This design ~~proposed by this document~~ suffers from the drawback of the conventional V-belt, in that the transmittable force is limited by the force transmittable from the elastomeric body to the cables incorporated therein. ~~Moreover fabrication, i.e.~~

30 ~~Manufacture~~ is also complicated by the requirement of precisely receiving the cables in the relevant recesses between the element and the filler. A disadvantage exists in that the pulley contacting limbs ~~tend to~~ deflect inwardly under high pressure, ~~so that insufficient clamping force is taken up by the element as a whole~~. It was suggested to fill up the recess ~~for receiving the tensile means, i.e. the space between the limbs by a~~

35 filler plate, preferably to be welded between and against said limbs. This solution

complicates the design of the belt and raises production costs. ~~The belt according to this solution was dimensioned to accommodate relatively large power transmissions.~~

The present invention thus seeks to improve the pull belt type for variable transmissions in ~~such a manner~~ that a relatively small smallest running diameter can be attained at application in a transmission, in particular a continuous variable transmission, without undue sacrifice to durability, ~~i.e. life span~~ of the belt, nor to force transmittable by the belt, and without undue complication of ~~the design and manufacture of the belt~~. In particular the invention aims to provide a design technically and economically applicable and without undue manufacturing efforts, more in particular in the area of relatively small power transmissions like at the conventional rubber V-belt designs.

According to the invention, such is attained by the characterising portion of claim 1. The ultimately thin tensile element as featured in the design according to the invention effects a very low bending stress in the tensile element, thus enables a relatively long life time ~~of the belt~~, or very small smallest running diameter ~~of the belt~~ at equal life time. This feature ~~of the invention~~ is made possible by ~~a measure to~~ extending the tensile element over a broadest possible width, i.e. possibly as broad as the belt or any element incorporated therein, however without contacting the sheaves of the pulley. In practice good results may be achieved with the width being from 0.5 up to 1 times the width of the belt or, if transverse elements are incorporated in the belt, from 0,5 to 0,9 times the width of the element at the effective running diameter of the belt. The tensile element is according to the invention preferably located central to the radial height of the belt. By this measure ~~according to the invention~~, the tensile stress within the tensile means is reduced to a minimum, specifically since it is combined with the feature of being a thin bladed means, i.e. having radial thickness of minimal amount.

~~By the above said features a belt according to the invention may in a first embodiment be used favourably both as a replacement of V-belts having a plurality of longitudinal grooves, since it requires only a small amount, in a flat layer of elastically deformable material, preferably at each side of the tensile means for creating a comparable amount of friction surface, while it may be bond easily over even smaller diameters and with equal contacting features at both radial sides of the belt.~~

~~The belt according to the invention may in a further elaboration also favourably be applied as a replacement of the tensile means as used in an arrangement like EP-A-0826901 by adopting the appropriate profiling for the elements thereof. With a belt~~

~~according to the present invention, the said V-belt arrangement may adopt even smaller running diameters, smaller pitch distances and higher power throughput.~~

~~In a third embodiment of the invention t~~The new belt is produced suitable for a continuous variable transmission by the provision of transverse means having a centre opening through which the tensile means is passed, and with an elastically deformable material located longitudinally in between the transverse means, and having an adhesive connection with a radial surface of the tensile means.

~~— In the above embodiments of the invention, a double layer of ultra thin material, is favourably applied, of which according to the invention radial facing sides are mutually connected, either mechanically or by an ultra thin layer of gluing material such as metal glue, an ending piece of strap is made endless. This is according to the invention most favourably performed when at least virtually the entire longitudinal length of so created endless means is provided with a double layer. Preferably however, a minimal overlapping part of three layers is created, e.g. up to 5% of the longitudinal length. In case the belt according to the invention is provided with transverse elements according to the invention, no in between glue is required, since use is favourably made of an intermediate elastically material adhered to both radial sides of a combined layer of tensile means, preventing the tensile means from being pulled to a loose assembly, forming a particular embodiment of mechanical connection between end parts of a single strap element.~~

The invention may also be characterised as a tensile belt where elasticity and stiffness requirements of the different subcomponents are split up in such a way that they are optimal for the requirement of that component. This leads to a tensile belt that is suitable for very small running radii and which has minimal internal losses leading to a high efficiency belt and low operating temperatures, which is specially important for belts that are partially or completely composed of polymers and/or elastomers.

In the current belt, transverse elements that are stiff enough to prevent deformation of the belt between the pulleys, reducing internal friction losses and forming a beam to resist the required clamping force of the pulley sheaves. These elements may favourably relatively easily be provided with a relatively high resistance to wear. The belt further includes spacing means of an elastic material with negligibly modules of elasticity to eliminate bending stresses in the belt and with a good bonding performance with the radial surface of e.g. a metal strap like tensile means. Thus a good transport of driving force from the tensile element to the transverse elements or vice versa is made possible. The spacing means is in this arrangement compression

loaded by the force transfer between tensile element and transverse element and vice versa, preventing peel of the bonding layer between spacing means and tensile element.

~~When a double layer of tensile sheet element is used, according to a specific~~
 5 ~~embodiment of the invention, a heavy duty metal grease is used between them, while~~
~~the sides are being sealed with a same elastomere as for the spacing means, leading~~
~~to wear reduction between the layers.~~

The invention will now be elucidated further according to a drawing in which:

FIGURE 1A to 1C relate to conventional rubber V-belts;

10 ~~FIGURE 2 is a first embodiment of the V-belt according to the invention, with~~
~~transverse elements mechanically coupled to a tensile means;~~

~~FIGURE 3 is a first alternative embodiment of a V-belt according to the invention;~~

~~FIGURE 42 is a perspective view of second and preferred alternative an~~
 embodiment of the V-belt according to the invention;

15 ~~FIGURE 53 is an illustration of different techniques according to the invention~~
~~for realising an endless tensile means within the belt;~~

~~FIGURE 64 schematically shows an alternative and preferred embodiment of~~
~~the tensile means, i.e. consisting of two layers;~~

20 ~~Figure 74 illustrates an advantage of the belt according to the invention when~~
~~applied as a replacement belt for a conventional belt;~~

~~Figure 85 illustrates a preferred shape of the transverse elements;~~

~~Figure 9 by sectional views of different transverse elements, illustrates possible~~
~~shapes of a transverse element according to the invention;~~

25 ~~FIGURE 106 illustrates a common manner of operating a conventional rubber V-~~
~~shaped belt in a continuously variable transmission;~~

~~FIGURE 117 illustrates the possible reduction in dimension of a transmission or~~
~~variator when the belt according to the invention is applied instead of a conventional~~
~~belt.~~

30 The following description departs from the overall shapes and elements of a V-
 belt and of the associated and mentioned manufacturing processes as commonly
 known per se. The invention is primarily found in the new design of the belt.
 Secondly the order and manner of assembling the separate components in the belt
 according to the invention are mentioned.

35 In figure 1, three conventional rubber belt types are represented, a first one
 suited for transmissions having a fixed transmission ration. A second one typically

adapted for variable ratio transmissions, and a third one typically adapted for uses with small running diameters, however, only suitable for a fixed ratio transmission.

In figure 1A the conventional rubber V-belt 1 for fixed ratio transmission is shown with an outer coating 2 all around the belt 1. It has a rubber body 5 of soft elastic nature, and a thin outer coating of a relatively hard elastic nature, however providing resistance to wear. Embedded in an embedding layer 3 of material specifically suitable for connecting to a tensile means 4. The tensile means 4 consists of a layer of relatively thin rope, e.g. a Kevlar material, wound equally distributed over the width of the belt. The radial thick body 5 prevents the belt from adopting small running diameters, however promotes a stable running of the belt in the V-groove between the sheaves of a pulley.

The belt according to figure 1B is modified in that no surrounding is outer body is provided, in that the body is of a stiffer rubber type and is at the radial inner side provided with transverse grooves, commonly distributed at even distances of between 0.8 and 1.5 cm. At the radial outer face, a reinforced layer of relatively stiff material 6 is provided, supporting the stiffness of the belt in axial direction, thereby enhancing the efficiency of the belt.

The belt according to figure 1C is provided with V-shaped grooves 8 extending in longitudinal direction, thereby increasing, i.e. regaining contacting area with correspondingly grooved fixed ratio pulleys of a small running diameters. No outer support layer 6 is required since the belt is not loaded with axial thrust originating from sheaves of a pulley.

~~Figure 2 represents a first principal modification of the V-type pull belt in accordance with an idea underlying the invention. It~~ The invention shows a separation in function of a transverse clamping means 13 and a tensile loadable body 11, in casu embodied by a flat strip of a tensile loadable material, preferably spring type steel or a synthetic tape of a synthetic uni directional (UD-) material. A transverse element 13 is mechanically coupled to the tensile body 11, ~~in casu by a pop nail construction known per se, wherein the nail is part of the transverse element. Internally it shows a U-shape, of which the bottom part forms a contacting face for contacting the tensile body. It is of a width matching that of the tensile body. The contacting face is centrally provided with a nail part.~~ The transverse element may be composed of metal but is preferably entirely composed of a synthetic material. ~~The nail part is inserted through an opening in the tensile body, and subsequently popped, either mechanically in case of a metal nail or thermo-mechanically in case of a synthetic material.~~

The strip 11 forming the tensile body 11 according to the invention, composed of metal like spring steel or of unidirectional synthetic tape ("UD-tape"), is of a thickness considerably smaller than that of the cords 4 applied in conventional tensile bodies. Typically the reduction in thickness is of a factor between 5 and 10 times the
 5 conventional thickness. According to the invention the metal or synthetic strip 11 applied is of a thickness between 0.04 and 0,25 mm, more preferably up to 0,1 mm, compared to conventional cord thickness of between 0.6 and 1.2 mm. This measure in accordance with the invention effects a considerable reduction of bending stress within the tensile body 11, implying a longer life time when a belt 10 with such tensile
 10 element 11 is run at a corresponding running radius, or an equal life time at a considerably smaller running radius.

The immense reduction in thickness of the tensile element 11 is in accordance with the invention made possible through the fact that the tensile element 11 is produced strip like, i.e. entirely flat. By this feature, compared to conventional layers of
 15 cord 4, the required small amount of space between the cords 4 is entirely occupied in width wise, i.e. lateral and axial direction. Very importantly, by this design of the tensile element 11, very high contacting pressures between tensile body or element 11 may be realised since a danger of the cords 4 cutting through the body of the transverse elements 13 or of an additional layer within the tensile body is strongly if not entirely
 20 taken away. In the present design, the transverse element 13 and the tensile body 11 mutually engage for driving action mechanically, ~~both by said inserted nail and by a frictional contact between contacting face and the tensile body.~~

~~_____~~ Another characterising feature of a design in accordance with the invention, is that the tensile body 11 is located centred in radial direction relative to the radial height
 25 of the contacting faces 14 of the transverse elements 13, thus further reducing the tensile load and stress on the tensile element 11 in the belt 10. In the present embodiment where the tensile body 11 is solely formed by a tensile strip 11, and where the thickness of the strip 11 may virtually be neglected, this implies that the effective point of contact or location of the friction force of a contacting face 14 is
 30 located virtually centred relative to the radial height of the contacting faces 14 of the element 13.

~~Figure 3 represents an alternative construction for the belt according to figure 2, in which the tensile body is provided with lateral ear parts or in reversed sense, with slot like openings. The openings show axial contacting rims by which the tensile body is contacted. The openings have a longitudinal depth fitting the thickness of a~~
 35

~~transverse element, at least the limb part thereof. The total width of the tensile body is less than the local width of the transverse elements, so as to prevent the tensile body from contacting the sheaves of the pulley. The axial width of the slotted opening substantially corresponds to the local width of the limbs of the transverse elements.~~

- 5 ~~Preferably the openings are created by bending the material originally present in the slot area in downward or upward direction, according to an axial folding line coinciding with an axial contacting rim for contacting a transverse element. The drawing, the transverse element may be provided with retractable limb parts for keeping the tensile element in place. Overlapping ends of the tensile element are fixed in longitudinal~~
- 10 ~~direction via said ear parts~~

The tensile body 11 may also be produced as a tensile strip 11 coated with an elastically deformable material 12 such as vulcanised rubber or a synthetic rubber material. The presence of the elastic material 12 in this context assists in levelling local pressure peaks, thus enhances lifetime of the belt.

- 15 In the embodiments according to figures 42 advantage is taken of the circumstance that in accordance with the invention it is relied on the shear force feature of the elastically deformable material of the intermediate body 12, rather than on the tensile force coefficient of this material, implying that a relatively high tensile force can be carried over in the tensile means 11. ~~For the latter reason a V-belt according to the invention may be embodied with a relatively small, i.e. thin layer of elastic material between the ends of the tensile element.~~
- 20 ~~according to the invention may be embodied with a relatively small, i.e. thin layer of elastic material between the ends of the tensile element.~~

Figure 42 schematically depicts the structure of an embodiment according to the invention in which connection between the tensile element 11 and the transverse element 13 is realised through an elastically deformable material 12, firmly bonded, i.e.

- 25 adhesively connected to the strip element 11, e.g. glued or otherwise bonded, with the material preferably extending over the width of the strip 11. In the embodiment according to figure 42, first the elements 13 are shifted over the tensile element 11 after which the elastic material 12 is applied. ~~According to an alternative embodiment of a manufacturing process, the tensile element is first coated with the elastic material after which the transverse elements are shaped with an injection moulding machine. In both embodiments for a manufacturing process~~
- 30 ~~The tensile body 11, 12 consists of a mirrored profiling at each of both radial inner and outer surface face of the tensile means 11. The elastic material 12 is at least present longitudinally in between two adjacent transverse elements 13 and is firmly connected to the strip element 11, i.e. it~~
- 35 has an adhesive bonding, either or not enhanced by mechanical or chemical treatment

of the radial surface area of the tensile means 11. It has a very high resistance against shear and peeling, alternatively denoted a high coefficient of adhesion. Preferably vulcanised rubber is used for this purpose, however, also a combination of dedicated surface treatment and a subsequent application of synthetic rubber showed useful results.

The transverse element 13 in these embodiments extends two sided over the tensile body 11, thus shows a centralised slotted opening 15 fitting a cross section of the tensile body 11. In accordance with the invention, the elements 13 ~~are moulded in location around the tensile means. Equally however, the transverse elements may be cut out of a piece of suitable material, or~~ may be individually (injection) moulded and subsequently be tacked or stringed to the tensile strip 11, brought into mutually correct position by means of a mallet. In case of moulded elements 13, a distance boss 16 is provided to the elements 13. Subsequently the elastic material 12 is provided by injection or ~~transverse~~ moulding, intermediate to the transverse elements 13.

Application of the intermediate elastic material 12 in the embodiment according to figure 4 can e.g. be done by one or more injection nozzles directed to the surface of the tensile strip 11. At each embodiment, the elastic material 12 is provided over a thickness of more than 1 mm above the strip surface and preferably at a maximum of half or less than a quarter of the total radial height of the contact face 14 of a transverse element. However, the gap between transverse elements 13 may without undue influence to the basic function of the belt also be filled entirely.

Preferably the central opening 15 in the transverse element 13 shows a rounding 17 or a chamfer 17 of the edges as seen in radial and – belt wise - longitudinal cross section. In this manner both the tacking of the elements 13 over the strip 11 is enhanced by the presence of a funnel like entry of the opening 18. Also, the contact between the element 13 and the elastic material 12 is optimised. Further it is realised that any damaging contact between element 13 and tensile strip 11, likely to be caused by a high surface pressure due to sharp edges at the element 13 is minimised. The latter shape of the element slot 15 according to the invention, at driving activation of a transverse element 13 by the sheaves of a pulley, urges the element 13 on to the intermediate material 12. By the chamfer 17 or otherwise manner of rounding, a funnel-like opening 18 is created at the central opening 15 of the element. The elastic material between two transverse elements 13, by the funnel shape 18, tends to become gradually compressed towards the surface of the tensile strip 11 under the influence of any longitudinal driving force of a transverse element 13, thus causing the

internal friction capacity of the elastic material 12 and the friction with the strip surface to be increased, optimising the transfer of driving power from the transverse element 13 to the tensile strip.

5 ~~Figure 8 and 9~~ shows an examples of such above described funnelled openings 18, in casu with a rounded, ~~respectively chamfered~~ opening. Due to subsequent injection of the intermediate material 12, the latter adopts the shape created in the opening 18 of the element 13.

10 ~~In the embodiment according to figure 4, the belt according to the invention may be produced by coating the strip element first, with a rubber or synthetic rubber like material, preferably in a profiling matching the above described chamfer or rounding, preferably symmetrically at both radial sides of the tensile body, and subsequently moulding the transverse elements in place, using a suitable mall for maintaining the tensile body in a desired position and shaping the transverse elements.~~

15 In accordance with the invention the transverse elements 13 are produced of a very stiff, i.e. non-compressible synthetic material, preferably fibre reinforced, having a high temperature resistance, i.e. preferably over 100 or even up to 150 degrees Celsius, and with a reasonable coefficient of friction in combination with metal sheaves. One such material is of the acetal group (POM). Any alternative matching such criteria, such as high tech thermosets like phenol based materials or high tech
20 engineering plastics with or without fibre filling may equally be applied however. Although a metal transverse element 13 could be used, the invention applies a synthetic material so as to more easily provide the elements 13 with the desired shape details, and so as to enhance manufacturing of the elements and equally to enhance assembly of the belt 10 according to the invention.

25 Figure 53 illustrates several manners of realising an endless tensile means 11 produced in a single layer effectively. The upper manner simply shows two end parts 20 of a tensile means 11 overlapping radially. A mechanical stopping means 21, 22 may be provided according to the invention, either by bending an end part 21 of the tensile means 11 transverse to the longitudinal direction, or by locating a rim 22 on a
30 radial face, e.g. a soldered rim.

~~Figure 64 in accordance with the invention shows a preferred manner of incorporating a tensile element in the new V-belt. In this shown embodiment the tensile means is produced in two layers. In the embodiment shown the tensile means consists of two parts. Preferably, though not depicted, the tensile means is produced of one
35 piece, with the ends overlapping to a small extend. In both embodiments the ends are~~

mutually interconnected via the transverse elements. Additional mechanical connections may be used, e.g. via the intermediate elastically deformable means. In this manner the tensile element is virtually made endless. The thickness of the element is in this case taken half the thickness required for transferring a force in the
 5 embedment with one layer effectively.

Figure 75 shows a further advantage of the present invention ~~which~~invention, which is most favourably used when the current belt 10 is applied as a replacement belt for a conventional rubber belt, i.e. in a variator of otherwise conventional dimension. Since the tensile means 11 is located radially centred, the driving force of
 10 the transmission is effectively located at radial lower point of up to 5 mm. This phenomenon is of a relative high significance at the smallest diameter, compared to the situation at the other driving wheel where the largest running diameter occurs at such instance. Thus in the initial stage of transmission, an improved so called launch performance, e.g. at scooters is achieved.

~~Figure 8 in detail shows a preferred embodiment of a transverse element, with distance bosses for mutually easily positioning the elements when strung on a tensile element. The bosses are located at the radial level of the tensile means. By the cross section on the right hand side of the figure, the rounded contact face of the elements for contacting the tensile means is shown, creating the earlier described, and
 15 favourable funnel shape. However, as illustrated by the comparable cross sections in figure 9, different shapes be chosen, including a triangular wedge shape and a simple slotted opening.~~

Advantages of the belt 10 according to the invention include the reduced smallest possible running diameter, and the small, material saving transmission case
 25 consequently required, an increased efficiency of the belt due to reduction of internal losses otherwise caused by compression, both in longitudinal and in axial direction, and an increased life time of the belt due to the use of reinforced, non-compressible synthetic material in the transverse elements, and to the reduced tensile stress in the tensile element, due to it's strongly reduced thickness. Moreover, the belt according to
 30 the invention may realise a significantly increased transfer of power due to the lower position of the tensile element as compared to conventional rubber V-belts.

Figure ~~40-6~~ and ~~44-7~~ together provide an indication of the effects attainable with a belt 10 according to the present invention. In Figure ~~406~~, schematically part of transmission line of a scooter is shown with the contour of a pulley sheave to the front
 35 side at the left hand side of the figure and one to the rear side at the right hand side in

the figure. At the front side the smallest possible running diameter is utilised since the take off or launching of a vehicle is only short lived. At the rear wheel however, the smallest running diameter, occurring in overdrive (OD) situation occurs most of the operation time of the vehicle. So as to enhance life time of the belt, the smallest running diameter is commonly limited to a diameter about twice ~~that of the~~ smallest diameter at the front pulley. With a belt 10 designed in accordance with the invention, such limitation may be omitted. Moreover the smallest possible running diameter is even further reduced, so that for achieving a comparable transmission ratio, the diameter of the pulleys may be reduced.

Figure ~~44-7~~ shows that the overall length of a transmission drive line may be significantly reduced. This may amount from about 75% of the smallest possible distance D2 between the axes of two conventional pulleys up to almost 50% of the currently applied space D1 between the pulleys of nowadays scooters. Thus the invention also relates to a scooter or alike vehicle, having a variator, with a belt 10 according to the invention, and integrated with the engine, i.e. incorporated within the dimensions thereof, and having a fixed ratio transmission, e.g. by a belt between the variator and the rear wheel.

When a belt 10 according to the invention is merely applied as a replacement belt, i.e. with a conventional dimensioning of the variator, still a significant advantage exists in a structurally higher potential of transferring power due to the low position of the tensile element 11. It may a.o. be used to enhance the driving characteristic of such vehicle in the LOW driving mode. For instance, the coupling may be tuned to close somewhat earlier, so that a driving force may already be transferred at lower engine speed, due to the enhanced torque transmission capacity in combination with a belt 10 according to the invention.

The invention apart from the preceding description and all details of the drawing in particular relates to the following set of claims.

ABSTRACT

~~The invention relates to a~~ drive belt for rotational transfer of a force between two or more drive wheels, ~~is~~ provided with a tensile ~~means~~ element for
5 transferring the force to be transferred between ~~said~~ the drive wheels, and a contact body for realising contact between the belt and the drive wheels, the contact body being composed of a plurality of transverse elements, and between which transverse elements, as taken in the longitudinal direction of the belt, in adhesive contact with the tensile means, is provided an intermediate body of a relatively soft elastically
10 deformable material. The tensile ~~means~~ element comprises a strap like ~~means~~ device of minimal thickness, the width of which strap like ~~means~~ device substantially corresponding to the width of the contacting body at the level of the tensile ~~means~~ element in the belt, and the strap like ~~means~~ device being incorporated in the belt with radial overlapping end parts.